Section 5. Renewable Energy Sources

Prices and expenditures for renewables energy sources are based on consumption estimates from the Combined State Energy Data System (CSEDS). Renewable energy sources reported in CSEDS include estimates of the residential and commercial sectors' use of solar and wood energy for 1990 forward; industrial sector consumption of hydroelectric power for all years; industrial use of solar, wind, geothermal, and wood and waste from 1990 forward; and electric utilities' use of hydropower and geothermal, wind, wood, waste, photovoltaic and solar thermal energy for all years. Transportation use of ethanol is included in the motor gasoline volumes in CSEDS for all years.

Hydroelectric, Geothermal, Wind, Photovoltaic, and Solar Thermal Energy

In CSEDS, it is assumed that there are no direct fuel costs for hydroelectric, geothermal, wind, photovoltaic, or solar thermal energy. CSEDS consumption values are adjusted by removing these fuels before calculating energy expenditures, as described in Section 7, "Consumption Adjustments for Calculating Expenditures," on page 417.

Wood and Waste

Prices are estimated for wood and waste in CSEDS. It is assumed that taxes are included in the prices reported on the Energy Information Administration Residential Energy Consumption Survey and the Manufacturing Energy Consumption Survey, which are used as the basis for the CSEDS price estimates.

Residential and Commercial Sectors

Physical Unit Prices, All Years

Prices paid for wood by the residential sector for 1970 forward are based on unpublished data from the Form EIA-457 "1980 Residential Energy Consumption Survey" (RECS 1980), and the "1993 Residential Energy Consumption Survey" (RECS 1993). The reported prices include taxes. The nine Census division average prices for residential wood from RECS 1980 are used to estimate prices for 1970 through 1989. The 1980 Census division residential wood prices are adjusted in proportion to the changes in U.S. average residential fuel oil prices each year compared to the 1980 fuel oil price. The Census division estimated prices are assigned to the States within each Census division for 1970 through 1989. The four Census region average prices for residential wood from RECS 1993 are used to estimate prices for 1990 forward. The 1993 Census division wood prices are adjusted in proportion to the changes in U.S. average residential fuel oil prices each year compared to the 1990 fuel oil price. The estimated Census region wood prices are assigned to the States within each Census region for 1990 forward.

The State-level residential wood prices are used for the commercial sector in all years.

Btu Prices, All Years

Prices in dollars per cord are converted to dollars to million Btu using the conversion factor of 20 million Btu per cord.

Data Sources

Prices

1990 forward: Energy Information Administration, unpublished data from Form EIA-457, "1993 Residential Energy Consumption Survey," Census region compilation of the answers to questions J-28 and J-33 through J-36.

1970–1989: Energy Information Administration, unpublished data from Form EIA-457, "1980 Residential Energy Consumption Survey," Census division compilation of data on average prices paid for wood purchased in 1980.

1970 forward: Energy Information Administration, U.S. average residential distillate fuel prices (DFRCDUS) from CSEDS.

Consumption

1970 forward: Energy Information Administration, Combined State Energy Data System, residential and commercial wood and waste consumption adjusted as described in Section 7, "Consumption Adjustments for Calculating Expenditures," on page 417.

Conversion Factor

20 million Btu per cord.

Industrial Sector

The industrial sector wood and waste consumption estimates and prices in CSEDS are developed by dividing industrial sector consumers into two groups—manufacturing industries, i.e., three or four Standard Industrial Classification (SIC) categories and nonutility power producers. Wood and waste consumption are estimated separately within the categories. The State-level industrial sector wood and waste prices are consumption-weighted averages of the consumption and prices of the individual categories. The consumption data used in the calculations are adjusted to account for wood and waste obtained at no cost. See the discussion in Section 7, "Consumption Adjustments for Calculating Expenditures" on page 417.

Btu Prices, 1994 Forward

Manufacturing Industries

For 1994 forward, industrial sector wood and waste prices are consumption-weighted averages based on unpublished data from the Form EIA-846 "1994 Manufacturing Energy Consumption Survey" (MECS 1994). MECS 1994 collects data on quantities consumed and quantities purchased in million Btu and expenditures in dollars for five types of wood and waste—pulping liquor, agricultural waste, wood harvested from trees, wood refuse and byproducts from mills, and wood and paper refuse. The quantities purchased and the expenditures are used to calculate average prices for each type of wood and waste. MECS 1994 also identifies consumption of the different types of wood and waste by SIC categories 20, 24, 25, 26, and other (a subtotal of SIC codes 21–23 and 27–30). For each of the SIC codes, an average wood and waste price is calculated by using the consumption of each of the five types of wood and waste to weight the average of their respective prices. These average prices by SIC code for 1994 are applied to the CSEDS estimates of wood and waste consumption by SIC code in each State to calculate State-level weighted average prices for 1994 forward. The CSEDS consumption data used to calculate expenditures are reduced to account for quantities obtained at no cost. See the discussion in Section 7, "Consumption Adjustments for Calculating Expenditures" on page 417.

Nonutility Power Producers

Although quantities of wood and waste used by nonutility power producers are available, prices are not available. The CSEDS electric utility sector annual average prices for wood and for waste are calculated and assigned to the nonutility power producers consumption each year. The consumption data are adjusted to account for quantities obtained at no

cost. See the discussion in Section 7, "Consumption Adjustments for Calculating Expenditures" on page 417.

Btu Prices, 1990 through 1993

Manufacturing Industries

For 1990 through 1993, industrial sector wood and waste prices are consumption-weighted averages based on unpublished data from the Form EIA-846 "1991 Manufacturing Energy Consumption Survey" (MECS 1991). MECS 1991 collects data on quantities consumed and quantities purchased in million Btu and expenditures in dollars for five types of wood and waste—waste materials, pulping liquor, round wood, wood chips, and biomass. The quantities purchased and the expenditures are used to calculate average prices for each type of wood and waste. MECS 1991 also identifies consumption of the different types of wood and waste by SIC categories 20, 24, 26, and other (a subtotal of SIC industries 21–25 and 27–30). For each of the SIC categories, an average wood and waste price is calculated by using the consumption of each of the five types of wood and waste to weight the average of their respective prices. These average prices by SIC code for 1991 are applied to the CSEDS estimates of wood and waste consumption by SIC code in each State to calculate State-level weighted average prices for 1990 through 1993. The CSEDS consumption data used to calculate expenditures are reduced to account for quantities obtained at no cost. See the discussion in Section 7, "Consumption Adjustments for Calculating Expenditures" on page 417.

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Btu Prices, 1986 through 1989

Manufacturing Industries

For 1986 through 1989, industrial sector wood and waste prices are consumption-weighted averages based on data from the Form EIA-846 "1988 Manufacturing Energy Consumption Survey" (MECS 1988). MECS 1988 collects data on inputs of energy for heat, power, and electricity generation and quantities purchased in billion Btu and expenditures in dollars for five types of wood and waste—waste materials, pulping liquor, round wood, wood chips, and biomass. The quantities consumed and the expenditures are used to calculate average prices for each type of wood and waste. MECS 1998 also identifies consumption of the different types of wood and waste by SIC categories 20, 24, 26, and other (mainly SIC 25). For each of the SIC codes, an average wood and waste price is calculated by using the consumption of each of the five types of wood and waste to weight the average of the respective prices. These average prices by SIC code for 1988 are applied to the CSEDS estimates of wood and waste consumption by SIC code in each State to calculate State-level weighted average prices for 1986 through 1989. The CSEDS consumption data used to calculate expenditures are reduced to account for quantities obtained at no cost. See the discussion in Section 7, "Consumption Adjustments for Calculating Expenditures" on page 417.

Nonutility Power Producers

Information on nonutility power producers' use of wood and waste became available beginning with 1989 data. Although quantities of wood and waste used by nonutility power producers are available for 1989, prices are not available. The CSEDS electric utility sector annual average prices for wood and for waste are calculated and are assigned to the nonutility power producers' consumption in 1989. The consumption data are adjusted to account for quantities obtained at no cost. See the discussion in Section 7, "Consumption Adjustments for Calculating Expenditures" on page 417.

Btu Prices, 1980 through 1985

For 1980 through 1985, industrial sector wood and waste prices are consumption-weighted averages based on data published in the

Manufacturing Energy Consumption Survey: Consumption of Energy, 1985 (MECS 1985), Table 2. MECS 1985 contains data on inputs of energy for heat, power, and electricity generation in trillion Btu for two types of wood and waste—major byproducts and other. MECS 1985 also identifies consumption of the two types of wood and waste by the SIC categories 20, 24, 26, and other (mainly SIC 25). Since no price data were collected on MECS 1985, the average prices for each of the SIC categories developed from MECS 1988 are applied to the MECS 1985 estimates of wood and waste consumption by SIC code in each State to calculate State-level weighted average prices for 1980 through 1985. The CSEDS consumption data used to calculate expenditures are reduced to account for quantities obtained at no cost. See the discussion in Section 7, "Consumption Adjustments for Calculating Expenditures" on page 417.

Btu Prices, 1970 through 1979

There are no data available for estimating industrial prices for wood and waste in 1970 through 1979. Therefore, the 1980 State-level average industrial sector wood and waste prices are used for all States in 1970 through 1979.

Data Sources

Prices

1994 forward: Energy Information Administration, unpublished data from Form EIA-846, "1994 Manufacturing Energy Consumption Survey," national data on quantities purchased, quantities consumed as fuel, and expenditures for pulping liquor, agricultural waste, wood harvested from trees, wood refuse and byproducts from mills, and wood and paper refuse, by Standard Industrial Classifications (SIC) categories.

1989 forward: Energy Information Administration, CSEDS electric utility sector national annual consumption-weighted average prices for wood and waste.

1990 forward: Energy Information Administration, CSEDS wood and waste consumption by SIC categories 20, 24, 25, 26, and other (SIC 21–23 and 27–30) developed from the U.S. Department of Commerce, Bureau of the Census, *1992 Census of Manufactures, Industry Series,* Table 2, data on value added in manufacture and number of employees.

1990 through 1993: Energy Information Administration, unpublished data from Form EIA-846, "1991 Manufacturing Energy Consumption Survey," national data on quantities purchased, quantities consumed as fuel, and expenditures for waste materials, pulping liquor, round wood, wood chips, and biomass.

1986 through 1989: Energy Information Administration, unpublished data from Form EIA-846, "1988 Manufacturing Energy Consumption Survey," national data on inputs of energy for heat, power, and electricity generation, quantities purchased, and expenditures for waste materials, pulping liquor, round wood, wood chips, and biomass by SIC categories.

1986 through 1989: Energy Information Administration, CSEDS wood and waste consumption by Standard Industrial Code for 1987 developed from the U.S. Department of Commerce, Bureau of the Census, *1992 Census of Manufactures, Industry Series,* Table 2, revised 1987 data on value added in manufacture and number of employees.

1980 through 1985: Energy Information Administration, DOE/EIA-0512(85) *Manufacturing Energy Consumption Survey: Consumption of Energy, 1985*, Table 2. National data on inputs of energy for heat, power, and electricity generation for "Major Byproducts" and "Other" by SIC categories.

1980 through 1985: Energy Information Administration, CSEDS wood and waste consumption by Standard Industrial Code for 1982 developed from the U.S. Department of Commerce, Bureau of the Census, *1982 Census of Manufactures, Industry Series,* Table 2, data on value added in manufacture and number of employees.

1970 through 1979: Energy Information Administration, CSEDS 1980 State-level prices for industrial wood and waste.

Consumption

1970 forward: Energy Information Administration, CSEDS, industrial biofuels consumption adjusted as described in Section 7, "Consumption Adjustments for Calculating Expenditures," on page 417.

Transportation Sector

Biomass fuels consumed in the transportation sector as ethanol mixed in gasoline is included in the motor gasoline volumes for all applicable years. Ethanol quantities and costs are included in the volumes and prices of motor gasoline.

Electric Utility Sector

State-level data on the amount of electricity generated at electric utilities from wood and waste are taken from CSEDS and are collected on the Form EIA-759, "Monthly Power Plant Report." All electric utilities are required to report on EIA-759 but no price data are collected. State and national wood and waste prices in dollars per million Btu are developed for the electric utility sector from data reported on other EIA and Federal Energy Regulatory Commission (FERC) forms and from telephone surveys. Taxes are included in the prices for all years.

Prices: All Years

1989 Forward. State-level prices for biomass fuels used at electric utilities, in dollars per million Btu, are calculated from data obtained from FERC Form 1, FERC-423, and Form EIA-412 and by follow-up telephone surveys of the electric utilities that are not required to submit those forms. For States with more than one utility using biomass fuels, a consumption-weighted average price is calculated. There are anomalies that are unique to biomass fuels used at utilities. In some cases, there is no charge for the fuel. In other cases of municipal and industrial waste, the electric utilities charge a "tipping fee" for accepting the waste. That is, instead of paying for the fuel, the electric utilities are paid to take the fuel. For States where all utilities pay nothing for the fuel or charge a fee for receiving it (see Table A46), a price of zero is assigned. Although the corresponding consumption is included in calculating the average price for fuels consumed by electric utilities in the State and the United States, the expenditure included is zero. The State and U.S. average electric utility fuel prices are, therefore, slightly lower because some of the fuel did not cost anything.

1983 Through 1988. A U.S. average price in dollars per million Btu is calculated and assigned to all States. The national price is a consumption-weighted average price based on data obtained from FERC Form 1 and Form EIA-412 and by follow-up telephone surveys of the electric utilities that report use of biomass fuels for generating electricity.

Prices are erratic for biomass fuels used at utilities. In addition to the anomalies of no charge for the fuel and the "tipping fee" mentioned above, handling refuse-derived fuel is more labor intensive than handling conventional fossil fuels. The labor expenses are included in the plant's operating costs, not the fuel costs. Biomass fuels prices are also erratic because the demand is relatively small and the pricing mechanism, even for a single facility, may change from year to year. A price or quantity change by a single major user affects the national price more significantly than for any other fuel.

1978 Through 1982. National average prices are derived from data collected on FPC Form 423 and published monthly by EIA in *Cost and Quality of Fuels for Electric Utility Plants (C&Q).* For these years, fossil-fueled plants with a combined capacity of 25 megawatts or greater were required to report on FPC Form 423. Annual prices of biomass fuels sold to electric utilities are developed as quantity-weighted monthly prices for those plants where wood chips and refuse were used as fuel. Beginning in 1983, the reporting threshold was raised to 50 megawatts,

Table A46. Wood and Waste Used at Electric Utilities at No Cost or For a Fee, 1989 Forward

State	Years
California	1989–1997
Connecticut	1989–1997
Hawaii	1989, 1990
Montana	1989–1994
Ohio	1989–1993

and very few plants reported use of biomass fuels on the Form 423 in 1983 and subsequent years.

A detailed review of data in *C&Q* showed that some entries were in error by factors of 10, 100, or 1,000. Accordingly, the following corrections were made. For 1982, the February, March, and April quantities for the Florida Power Corporation were divided by 1,000 to make them 80, 40, and 60 short tons, respectively. The March, April, and May costs for Northern States Power were multiplied by 100 to make them $0.70 per million Btu. For the 5 months from November 1979 through March 1980, the reported quantities of wood delivered to Burlington Electric Co. were divided by 10 in order to place them in the range of 7,980 to 9,390 short tons. For the 8 months from June 1978 through January 1979, seed corn delivered to the Logansport Indiana Electric Department were included in the biomass fuel. For February 1978, the reported quantity of wood delivered to the United Power Associates was divided by 1,000 to make it 90 short tons.

1970 Through 1977. The annual prices for wood chips are derived by deflating the 1978 price by using the gross domestic product implicit price deflator based on 1987 dollars. The deflators are shown in Table A47.

Table A47. Price Deflators Used for Wood and Waste Prices, 1970–1977

Years	Deflator	Years	Deflator
1970	35.1	1975	49.2
1971	37.1	1976	52.3
1972	38.8	1977	55.9
1973	41.3	1978	60.3
1974	44.9		

Data Sources

Prices

1983 forward: Energy Information Administration, data reported on FERC Form 1, "Annual Report of Major Electric Utilities, Licensees and Others;" Form EIA-412, "Annual Report of Public Electric Utilities;" FERC-423, "Monthly Report of Cost and Quality of Fuels for Electric Plants;" and follow-up telephone surveys of the electric utilities that report use of biomass fuels for generating electricity.

1978-1982: Energy Information Administration, *Cost and Quality of Fuels for Electric Utility Plants*, table titled "Wood Chips, Refuse, and Petroleum Coke Used as Fuel by Steam-Electric Plants."

1970-1978: Energy Information Administration, *Annual Energy Review 1991*, Appendix C, Gross Domestic Product and Implicit Price Deflator.

Consumption

1970 forward: Energy Information Administration, CSEDS, electricity generated from consumption of wood and waste.